

## Technical Memorandum

*Via e-mail*

**DATE:** March 5, 2019

**FROM:** Amber Bacom, Mark Follansbee (SRC)

**TO:** David Berry (EPA)

**SUBJECT:** Screening Level Human-Health based Values for the Upland Area of the Richardson Flat OUs-2/3 Site

---

### 1.0 Introduction

The purpose of this technical memorandum is to summarize the process for and results of calculations of screening level human-health based values for arsenic and lead in the upland soil areas associated with the parcel SS-47 located within Operable Units 2 & 3 (OUs-2/3) at the Richardson Flat Site. The values are intended to represent interim screening levels for Richardson Flat, OUs-2/3 only. The purpose of deriving interim screening levels is to provide site specific risk management guidance while the U.S. Environmental Protection Agency (EPA) continues to conduct a site risk assessment, which will supersede this memorandum once completed.

The values derived herein represent screening soil concentrations below which no removal action is warranted and above which risk management/removal action may be warranted. These calculated values are human health screening values that are purposefully health protective and are values that support an unrestricted, future land use where potential risk/hazard are acceptable to EPA. These screening values are not applicable to ecological receptors and are not intended to address ecological risk. Site-specific Preliminary Remediation Goals (PRGs) will be developed following the completion of the human health risk assessment (HHRA) to further support risk management decisions.

In order to calculate human-health based screening values, the following general process was followed:

1. First, a risk-based concentration (RBC) was calculated using contaminant-specific toxicity values and exposure parameters. The RBC values were corrected for site-specific relative bioavailability for arsenic and lead as performed following the *in vitro* EPA Method 1345.
2. Second, the RBC was compared to background concentrations measured in upland background soils of OU-2/3 at the site (EPA 2018a).

3. The lowest RBC that is no less than the background concentrations at the site was selected as the screening level value.

At present, there are no residential properties within the upland areas of OUs-2/3 at the Site. However, future land use may include such development. Several commercial properties currently exist within the upland boundaries and additional future development is also possible. As such, screening level human health-based values for arsenic were developed in this memorandum for both a residential scenario and a commercial worker scenario. However, for lead, only the residential scenario was considered as it is most conservative. Because of uncertainty in future land use as well as the possibility of a child trespasser<sup>1</sup>, the screening level human-health based value for lead is based on an assumption of full-time residential land use.

All tables and figures are presented at the end of the memorandum.

## **2.0 Site-Specific Exposure Parameters**

Default exposure parameters consistent with those used to develop EPA's risk-based regional screening levels (RSLs) for generic residential and composite worker scenarios (EPA 2018b) were utilized to derive the screening level human-health based values presented herein. The exception being the use of site-specific relative oral bioavailability (RBA) values for arsenic and lead, as reported in the background technical memorandum (EPA 2018a). EPA default RBAs for arsenic and lead are 0.60 (EPA 2018b). Relative oral bioavailability was studied for arsenic and lead using a subset of soil samples collected from the upland background areas of OUs-2/3 (EPA 2018a). Table 1 lists the site-specific RBA values for the upland background areas of OUs-2/3.

## **3.0 Calculation of Screening Level Values for Lead in Soil**

A screening level human-health based value was developed for lead to assist in informing site-specific risk-management decisions. The screening level human-health based value for lead derived in this memorandum is to be applied to each residential parcel (decision units are generally assumed to be 0.25-1 acre lots for future residences) as a not-to-exceed value for the area-weighted average lead concentration to ensure protectiveness for future residential land use (this screening value would be protective of all other land uses). This screening value was developed using the IEUBK Model for Lead in Children, version 1.1, build 11 with updates recommended by the TRW Lead Committee and site-specific data for RBA information for lead in soil (see Tables 2 and 3).

The screening level human-health based value for residential land use was calculated using the IEUBK model as described above with a target risk of no more than a 5% chance of exceeding a

---

<sup>1</sup> The PRG derived from the Adult Lead Methodology is frequently higher than the PRG associated with infrequent child trespasser scenarios using the IEUBK model.

blood lead level of 5 µg/dL (P5) for children 12-72 months in age. This results in a screening level human-health based value for residential land use of 262 ppm (see Figure 1). This value exceeds the site background values for OUs 2&3 (for lead the mean and 95UCL background were 66 and 93 ppm, respectively EPA, 2018a).

#### 4.0 Calculation of Screening Level Values for Arsenic in Soil

Screening level human-health based values were developed for arsenic in accordance with the methodology outlined in the EPA RSL User's Guide (EPA 2018b). The EPA RSL equations<sup>2</sup> for a resident and a composite worker were used for deriving the screening level human-health based values presented herein assuming a target risk level of 1E-06 and a target hazard quotient (HQ) of 0.1. For the residential scenario, the screening level values were calculated as the time-weighted averages (TWA) assuming lifetime exposure beginning in childhood and extending into adulthood. Default values consistent with those used in the EPA RSL equations were used for the exposure parameters, except for the RBA (see Section 2.0). Tables 4 and 5 present the values for the various parameters used to calculate the screening level human-health based values. Table 4 presents the receptor-specific exposure parameters. Table 5 presents the toxicity values for arsenic and other contaminant-specific parameters.

The calculated RBCs for arsenic are listed in Table 6. Typically, the lower of the carcinogenic and noncarcinogenic values is selected as the value protective of both carcinogenic and noncarcinogenic effects. For both the resident and the worker, the carcinogenic values of 1 and 5 mg/kg, respectively based on a target risk of 1E-06 are lower than the non-cancer values based on a target HQ of 0.1. However, these concentrations are below the measured arsenic concentrations in background soils (mean and 95UCL background are 7.2 and 8.8 ppm, respectively EPA, 2018a). The non-cancer-based RBCs for the resident and the worker of 19 and 76 ppm, respectively based on a target HQ of 0.1, are above the background arsenic concentrations.

As shown in Table 7, these non-cancer-based RBC values are protective of cancer risks at a target risk level of 1E-04 (EPA Superfund guidance considers excess cancer risks that range between 1E-04 and 1E-06 to be generally within an acceptable risk range; EPA 1991). Similarly, the non-cancer-based RBC at a target HQ of 0.1 for the TWA resident is protective of non-cancer hazards to a child resident based on a HQ of 1.0 (EPA Superfund guidance states that no appreciable risk that non-cancer health effects will occur if the HQ value is equal to or less than one; EPA 1989). Evaluating risks to the young child (0-6 years) is considered protective of exposures to older children and adults. Similar to lead, these screening level human-health based values are intended to represent not-to-exceed values for the area-weighted average arsenic concentration.

<sup>2</sup> <https://www.epa.gov/risk/regional-screening-levels-rsls-equations>

## 5.0 Summary

This technical memorandum was prepared to calculate the following interim screening level human-health based values for arsenic and lead to account for hypothetical future land development within the upland areas of the OUs-2/3 at the Richardson Flat Site.

Analyte	Residential Screening Value	Worker Screening Value
Arsenic	19	76
Lead	262	n/a

These screening level human-health based values are preliminary and may be updated/changed based on additional data collected during RI activities. The values shown in the table above are based on site-specific bioavailability measurements within the upland area. As such, these values are intended to be used for screening assessment purposes for the SS-47 parcel to facilitate removal decision making. Site-specific information on the bioavailability of arsenic and lead within OUs-2/3 is based on data from numerous parcels within the site boundary. These values can be used as screening values for other areas of potential development and parcels within the Richardson Flat OUs-2/3 with the understanding that when the risk assessment is completed for the site, these values will be superseded by site-specific remediation objectives.

## 6.0 References

CDC. 2010a. National Health and Nutrition Examination Survey. 2003-2004 Examination, Dietary, and Demographics Files. Retrieved October 4, 2010 from <http://www.cdc.gov/nchs/nhanes/nhanes2003-2004>.

CDC 2010b. National Health and Nutrition Examination Survey. 2005-2006 Examination, Dietary and Files. Retrieved October 4, 2010 from <http://www.cdc.gov/nchs/nhanes/nhanes2005-2006>.

EPA. 1989. Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part A).

EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

EPA. 1994a. Guidance manual for the Integrated Exposure Uptake Biokinetic Model for lead in

children. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Publication Number 9285.7-15-1.EPA/540/R-93/081.

EPA. 1994b. Technical support document: Parameters and equations used in the Integrated Exposure Uptake Biokinetic Model for lead in children (v0.99d). U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. EPA 540/R-94/040.OSWER 9285.7-22.

EPA. 2006. Guidance for Evaluating the Oral Bioavailability of Metals in Soils for Use in Human Health Risk Assessment. OSWER 9285.7-80.

EPA. 2010a. Final Six-Year Review of National Primary Drinking Water Regulations: “Final\_6Yr\_Lead\_12.23.10.accdb”. Microsoft Access Database. As provided by Rebecca Allen, U.S. EPA Office of Groundwater and Drinking Water. Received December 23, 2010.

EPA. 2010b. The Analysis of Regulated Contaminant Occurrence Data from Public Water Systems in Support of the Second Six-Year Review of National Primary Drinking Water Regulations. Office of Ground Water and Drinking Water. EPA-815-B-09-006. September. Available online at:  
<http://water.epa.gov/scitech/datait/databases/drink/sdwisfed/howtoaccessdata.cfm>

EPA. 2016. OLEM policy directive: Updated scientific considerations for lead in soil cleanups. Directive (OLEM Directive 9200.2-167). U.S. Environmental Protection Agency.

EPA. 2017a. Update to the Adult Lead Methodology’s Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters. OLEM Directive 9285.6-56.

EPA. 2017b. Recommendations for Default Age Range in the Integrated Exposure Uptake Biokinetic (IEUBK) Model. OLEM Directive 9200.2-1.

EPA. 2018a. Memorandum: Richardson Flat OU2/3 Background Determination (Richardson Flat Site). David Berry to Rob Parker. Dated: August 7, 2018.

EPA. 2018b. Regional Screening Levels (RSLs) – User’s Guide. November. Available online at:  
<https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide>

FDA. 2010. Total Diet Study. U. S. Food and Drug Administration, Center for Food Safety and Applied Nutrition. Accessed on July 14, 2010 from  
<http://www.fda.gov/Food/FoodScienceResearch/TotalDietStudy/ucm184293.htm>

Parsons, R.; Munuo, S.S.; Buckman, D.W.; Tooze, J.A.; Dodd, K.W. 2009. User’s Guide for Analysis of Usual Intakes

Tooze, J.A.; Midthune, D.; Dodd, K.W.; Freedman, L.S.; Krebs-Smith, S.M.; Subar, A.F.; Guenther, P.M.; Carroll, R. J.; Kipnis, V. 2006. A New Statistical Method for Estimating the

Usual Intake of Episodically Consumed Foods with Application to their Distribution. J. Amer. Diet. Assoc. 106(10): 1575-87.

von Lindern, I., S. Spalinger, M.L. Stifelman, L.W. Stanek, and C. Bartrem. 2016. Estimating Children's Soil/Dust Ingestion Rates through Retrospective Analyses of Blood Lead Biomonitoring from the Bunker Hill Superfund Site in Idaho. Environ. Health Perspect. 124(9):1462-1470. Available on-line at <http://dx.doi.org/10.1289/ehp.1510144>.

**Table 1. Site-Specific Background Relative Bioavailability Values**

Analyte	Default RBA Value	Site-Specific RBA Value	Relative change
Arsenic (As)	0.60	0.33	-45%
Lead (Pb)	0.60	0.46	-23%

**Table 2. IEUBK Input Parameters Based TRW Lead Committee Recommendations**

Parameter	Value	Basis
Soil concentration (mg/kg)	$C_{\text{soil}}$	EPC soil concentration for the DU or residential yard
Dust concentration (mg/kg)	$C_{\text{dust}} = 0.7 \cdot C_{\text{soil(weighted)}} + (\text{air conc} \cdot 100)$	Indoor dust lead is derived from residential soil data using Msd (default shown)
Outdoor air concentration ( $\mu\text{g}$ per cubic meter [ $\text{m}^3$ ])	0.1	IEUBK Default
Indoor air concentration ( $\mu\text{g}/\text{m}^3$ )	30% of outdoor air concentration	IEUBK Default
Drinking water concentration ( $\mu\text{g}$ per liter [L])	0.9	EPA (2010a, 2010b)
Maternal PbB at birth ( $\mu\text{g}/\text{dL}$ )*	0.6	Based on National Health and Nutrition Examination Survey (NHANES) update (2009-2014) see EPA (2017a)
Absorption Fractions ( $\text{AF}^\dagger$ ) at low intakes:		
Air	32%	IEUBK Default
Diet	50%	IEUBK Default
Water	50%	IEUBK Default
Soil/Dust	23%	Site Specific based on EPA (2018a)
Sediment and disturbed surface water	23%	Site-specific based on EPA (2018a)
Fraction soil	45%	IEUBK Default
GSD	1.6	IEUBK Default
Target PbB	5 $\mu\text{g}/\text{dL}$	Mid-point of the range from EPA (2016)

\*Maternal PbB at birth does not impact results for the 12-72 month age range.

$\dagger \text{AF}\% = \text{RBA}\% \cdot 0.5$ .

**Table 3. Age-dependent Inputs to the IEUBK Model Based on EPA (2016)**

Age <sup>1</sup> (months)	Air		Diet <sup>3</sup>	Water <sup>4</sup>	Soil-Dust <sup>5</sup>
	Time Outdoors (hrs)	Ventilation Rate <sup>2</sup> (m <sup>3</sup> /day)	Dietary Intake (µg/day)	Intake (L/day)	Intake IR <sub>SD</sub> (mg/day)
0 to <12	1.0	3.22	2.66	0.4	86
12 to <24	2.0	4.97	5.03	0.43	94
24 to <36	3.0	6.09	5.21	0.51	67
36 to <48	4.0	6.95	5.38	0.54	63
48 to <60	4.0	7.68	5.64	0.57	67
60 to <72	4.0	8.32	6.04	0.6	52

<sup>1</sup>The age range of the IEUBK model is 12-72 months (EPA, 2017b)

<sup>2</sup>The values shown are the midpoint of the age range and are for illustration only. This version of the IEUBK model (version 1.1, build 11) uses the estimated regression equation to calculate inhalation rate as a continuous non-linear function of age. These midpoint values are provided for information only.

<sup>3</sup> TRW Lead Committee analysis. Dietary Pb Concentration 1995-2005 TDS (FDA, 2010); Dietary Intake 2003-06 NHANES WWEIA (CDC, 2010a, 2010b); Methodology NCI Method (Parsons, 2009; Tooze et al., 2006)

<sup>4</sup> TRW Lead Committee Analysis of Office of Water Six-Year data (EPA, 2010b)

<sup>5</sup> von Lindern et al. (2016).

**Table 4. Receptor-Specific Exposure Parameters<sup>1</sup>**

Exposure Parameter	Variable Name	TWA Resident	Worker	Units
Averaging Time (Noncancer)	AT <sub>nc</sub>	9,490 <sup>2</sup>	9,125	days
Averaging Time (Cancer)	AT <sub>ca</sub>	25,550	25,550	days
Exposure Duration	ED	6 (child) 20 (adult)	25	years
Exposure Frequency	EF	350	250	days/year
Exposure Time	ET	24	8	hours/day
Body Weight	BW	15 (child) 80 (adult)	80	kilograms
Ingestion rate (soil)	IRS	200 (child) 100 (adult)	100	mg/day
Surface area	SA	2,373 (child) 6,032 (adult)	3,527	cm <sup>2</sup>
Adherence factor	AF	0.2 (child) 0.07 (adult)	0.12	mg/cm <sup>2</sup>
Particulate emission factor	PEF	1.36E+09	1.36E+09	m <sup>3</sup> /kg
Target risk	TR	1E-06	1E-06	unitless
Target hazard quotient	THQ	1	1	unitless

<sup>1</sup>Values based on the default exposure parameters for a resident utilized in EPA (2018b).

<sup>2</sup>Assumes a total ED for the resident of 26 years (6 years as a young child; 20 years as an adult).

**Table 5. Toxicity Values for Arsenic<sup>1</sup>**

Parameter	Value	Units
Reference Dose (RfD)	3.00E-04	mg/kg-day
Reference Concentration (RfC)	1.50E-05	mg/m <sup>3</sup>
Oral Slope Factor (SFO)	1.50E+00	(mg/kg-day) <sup>-1</sup>
Inhalation Unit Risk (IUR)	4.30E-03	(µg/m <sup>3</sup> ) <sup>-1</sup>
GIABS	1	unitless
ABSd	0.03	unitless

<sup>1</sup>Values are based on inorganic arsenic.

**Table 6. Summary of Soil Screening Levels for Arsenic**

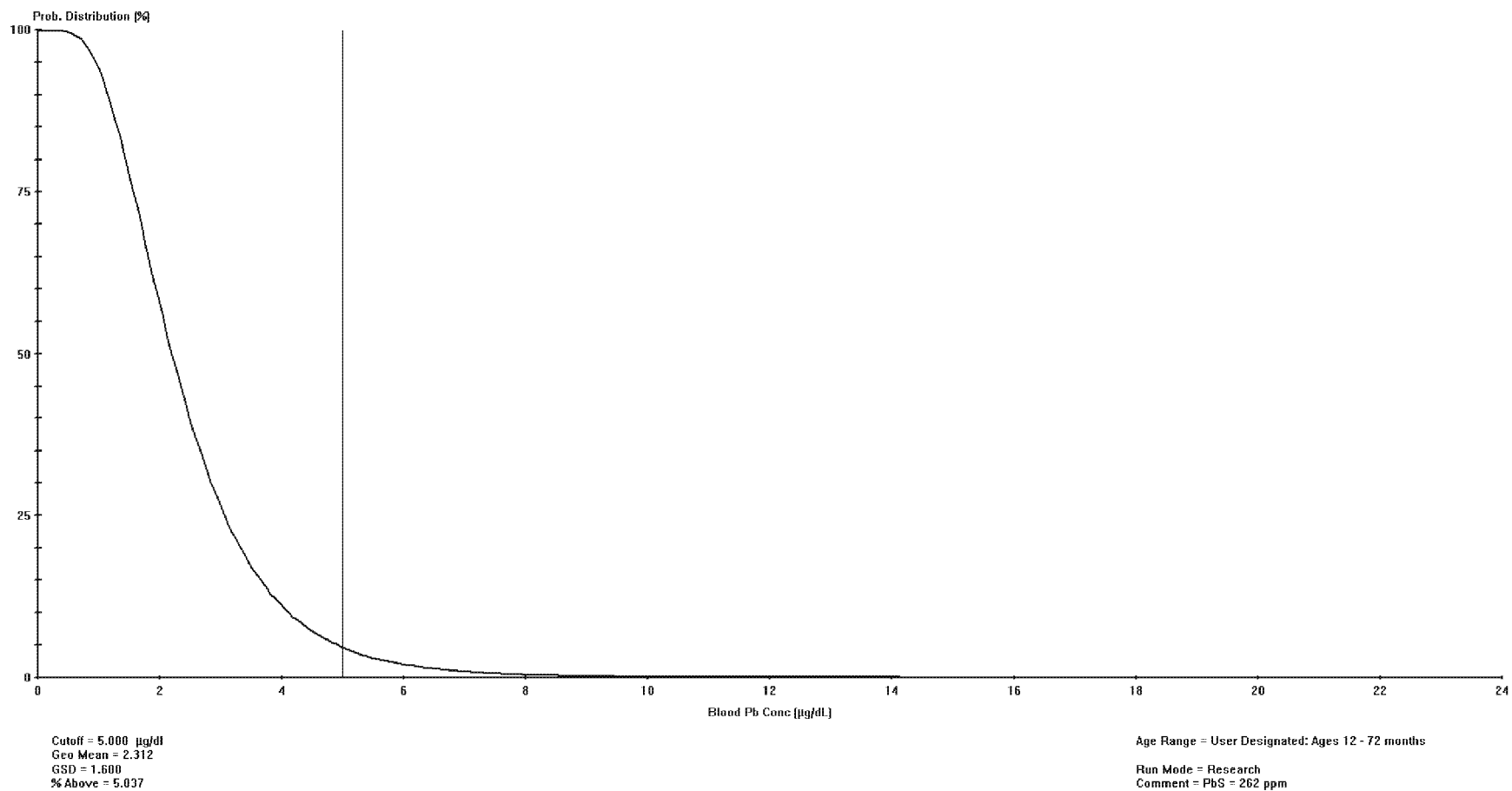
Receptor	Carcinogenic RBC (mg/kg) <sup>1</sup>	Noncarcinogenic RBC (mg/kg) <sup>2</sup>
Resident	1	19
Worker	5	76

<sup>1</sup>Target Risk = 1E-06

<sup>2</sup>Target Hazard Quotient = 0.1

**Table7. Summary of Alternative Soil Screening Levels for Arsenic**

Receptor	Carcinogenic RBCs (mg/kg)			Noncarcinogenic RBCs (mg/kg)	
	Risk = 1E-04	Risk = 1E-05	Risk = 1E-06	HQ = 1	HQ = 0.1
TWA Resident	112	11	1	185	18.5
Child Resident				58	5.8
Worker	477	47	4.7	760	76



**Figure 1.** IEUBK model (V1.1, build 11) results for 12-72 month P5 using OU2&3 site-specific RBA data for the background areas.